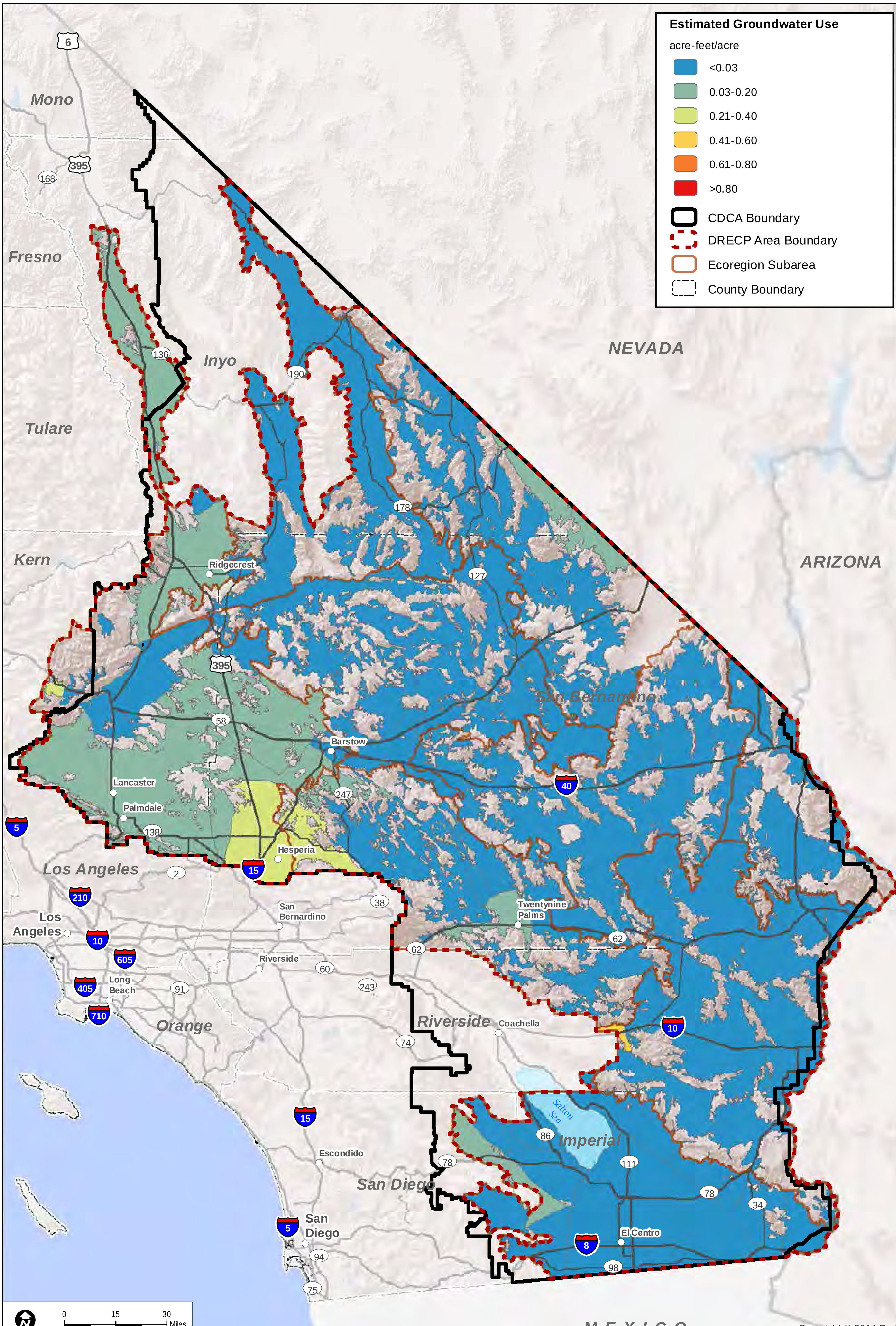

Sources: DWR, California Groundwater Elevation Monitoring, Basin Prioritization Process, December 2013; ESRI (2014)

FIGURE III.6-13

Estimated Groundwater Use

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The degree of subsidence depends upon the amount of groundwater-level lowering and the compressibility of sediments. In the western portion of the DRECP area, groundwater levels in some basins have declined more than 100 feet from predevelopment conditions. For example, in the Antelope Valley up to 6 feet of subsidence occurred between 1950 and 1990 from groundwater pumping and associated water-level declines of up to 90 feet (Londquist et al. 1993). There have also been water-level declines of many tens of feet during the second half of the 20th century in basins along the Mojave River, and farther east from the Lucerne Valley to Morongo Valley Region. Concurrent geodetic monitoring was implemented only in the Lucerne Valley Basin, however, where up to 2 feet of subsidence were recorded (Sneed et al. 2003).

The effects of subsidence can sometimes be obvious (with ground fissures and changes in surface drainage patterns), but can be undetected. Furthermore, subsidence can continue for decades even in the absence of additional water-level declines because substantial time is required for pore-pressures within the clay beds and adjacent aquifer materials to equalize. Subsidence creates an irreversible loss in aquifer storage capacity.

III.6.3.4.2 Geothermal Extractions

Most existing geothermal energy production in the DRECP area is in or near Imperial Valley, where commercial geothermal production dates back to 1961 (Singer 2004). Proposed additional geothermal leasing by BLM is in the adjacent West Chocolate Mountains area (BLM 2011). The BLM is also considering leases in the area of the Coso Geothermal Field, north of Ridgecrest, in the Haiwee Geothermal Leasing Area. Depending on local hydrogeology, well depth, and method of operation, withdrawal of fluids by geothermal wells can potentially cause both downward water leakage from overlying water supply aquifers and land subsidence.

The risk of inducing downward flow to geothermal wells from overlying water-supply aquifers is typically minimized by the large depth difference between most water supply wells and most geothermal wells. For example, water supply wells in the Imperial Valley area are typically 350 to 1,300 feet deep (Loeltz et al. 1975; Alward and Shatz 2009), whereas geothermal wells in the nearby Salton Sea, New Truckhaven and Orita project areas are 3,000 to 14,325 feet deep, with typical depths in the 5,000- to 8,000-foot range (Singer 2004; Nevada Geothermal Inc. 2011; Ram Power Corporation 2010). The potential for deep fluid extraction to affect shallower aquifers also depends on the type and extent of geologic layers in the depth interval between the geothermal well screen and nearby water well screens. Continued or increased pumping from geothermal wells could induce percolation from shallow aquifers or reduce production in geothermal wells. Injection of water into the geothermal wells may be needed to maintain continued production.

All basins in the DRECP area are at risk of subsidence as a result of geothermal extractions (BLM 2008), and concerns over that issue caused long delays in development of the Imperial Valley geothermal fields. In extreme cases, geothermal well operation has caused up to 42 feet of subsidence in other parts of the world (Wairakei, New Zealand), but so far there is evidence of little if any geothermal subsidence in the Imperial Valley (Northern Arizona University 2011).

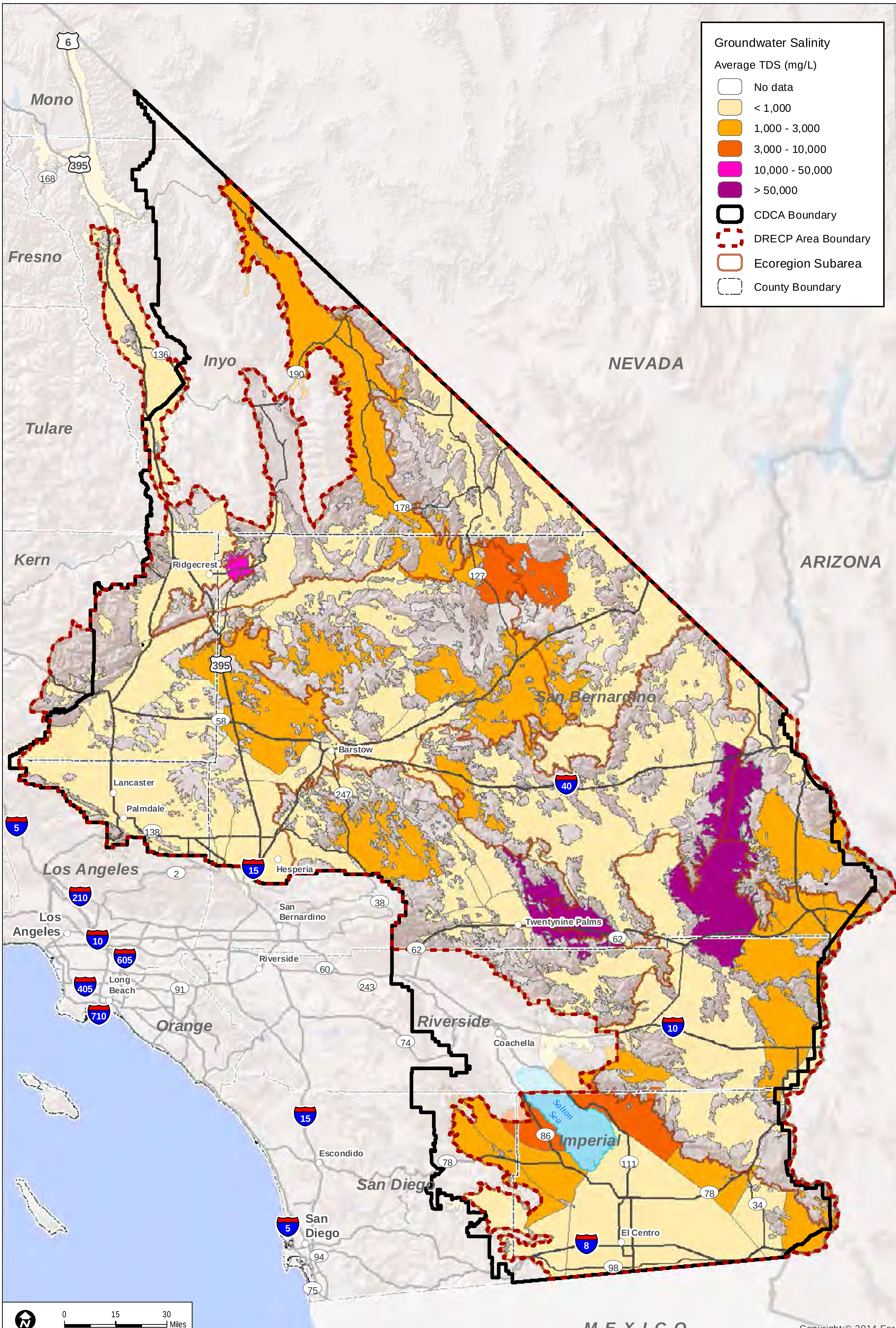
III.6.3.5 Water Quality

III.6.3.5.1 Groundwater Salinity

Groundwater salinity can significantly vary within individual groundwater basins, particularly in basins with discharging playas (see Figure III.6-8 for playa locations). Highly saline playas are characteristic of the DRECP area. Groundwater evaporation from the playa surface leaves salts behind, which accumulate over geologic time to form brines many times saltier than seawater. These hypersaline brines are generally restricted to shallow aquifers in the immediate vicinity of the playa. However, groundwater pumping from wells in a basin can alter—and even reverse—natural groundwater flow directions and cause the brines to migrate away from the playa into areas that formerly contained relatively fresh groundwater.

Figure III.6-14 shows a map of approximate average salinity in the DRECP area groundwater basins tabulated from basin descriptions in Bulletin 118 (DWR 2003). Salinity is represented here as the concentration of total dissolved solids (TDS). Water quality data are typically very sparse; some basins have no data and others have only one or two data points. Basins with several data points often include one or two values that are much higher than the rest. In some cases, these outliers were omitted from averaging so that the result would not be biased by local high-salinity conditions associated with a single playa. The color-coded salinity ranges correspond to suitability for beneficial uses. TDS concentrations less than 1,000 milligrams per liter (mg/L) meet secondary drinking water standards (for short-term use), and concentrations less than 3,000 mg/L are generally considered usable for irrigation.[4] Higher-salinity ranges are also shown, but those averages might be influenced by relatively high outliers. Some basins, such as Bristol Valley, have localized areas of high salinity groundwater that are not reflected in the average salinity shown in Figure III.6-14.

[4] 1 milligram per liter (mg/l) is the same as 1 part per million (ppm).



Sources: ESRI (2014); California Department of Water Resources (2003)

FIGURE III.6-14
Average Groundwater Salinity

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Figure III.6-14 reveals several regional patterns. Basins in the northwestern part of the DRECP area adjacent to the Sierra Nevada and San Bernardino mountains have relatively fresh groundwater, probably due to relatively high recharge from rainfall and streams emanating from those mountains. In the central and eastern portions of the DRECP area, TDS concentrations average over 1,000 mg/L. A zone of relatively high groundwater salinity is present in the Salton Sea area.

In basins that have high ambient TDS concentrations, potential beneficial uses of groundwater are limited and impacts of altered water quality patterns may consequently be smaller. High salinity water can be treated and made useable, especially if it is the only water available.

III.6.3.5.2 Other Constituents in Groundwater

Water classifications in the DRECP area vary both on a regional scale and a basin scale; however, certain dissolved ions dominate in these desert basins. Sodium, bicarbonate, sulfate, and chloride are the dominate ions, and calcium is also present in many of the water classifications. Shallow groundwater quality near the playas is often dominated by sodium chloride ions and sometimes by calcium chloride.

Almost every basin with a water quality record contains high values of fluoride. Other common water quality constituents of concern include boron, chloride, sodium, and sulfate. Without treatment, the high fluoride concentrations can prevent domestic uses and the high sodium and boron levels can prevent irrigation uses. Within the Copper Mountain Valley Basin, septic tank failures threaten water quality. Similarly in the Lower Mojave River Valley Basin, wastewater discharge also threatens aquifer water quality. In Imperial Valley, recharge from the New River degrades groundwater. Other constituents in groundwater that are of particular concern, especially in the Lahontan Region, include arsenic and chromium, which are both naturally occurring and associated with anthropogenic sources. Finally, leaking underground storage tank (LUST) sites and industrial federal Superfund sites within the Upper and Lower Mojave River Valley basins are contaminated with methyl tertiary butyl ether (MTBE), trichloroethylene (TCE), benzene, toluene, ethylbenzene, xylene (BTEX,) and other petroleum-based compounds. MTBE and BTEX are typically associated with gasoline storage tank leaks, and TCE is associated with industrial facilities.

III.6.4 Groundwater, Water Supply, and Water Quality Within the DRECP Area by Ecoregion Subarea

The DRECP area has been divided into 10 planning ecoregion subareas. The ecoregion subarea boundaries do not follow DWR basin boundaries, and some DWR basins can be located in two or more DRECP ecoregion subareas. In the following sections, the groundwater, water supply, and water quality characteristics are described for each ecoregion subarea by collating and summarizing the information available for basin areas within the ecoregion subarea. Herein, the area of overlap between ecoregion subarea boundaries and individual DWR basin boundaries are referred to as sub-basin areas.

III.6.4.1 Cadiz Valley and Chocolate Mountains Ecoregion Subarea

The Cadiz Valley and Chocolate Mountains ecoregion subarea contains all or portions of 18 mapped DWR groundwater basins with a combined area totaling 2,282,000 acres. Table III.6-2 lists the basin names, each basin's total area, and its sub-basin area located within the ecoregion subarea. Additionally, Table III.6-2 reports the corresponding sub-basin areas disturbed by either agriculture or other developed land uses, and the footprint of existing renewable energy projects (in acres) whose mapped locations fall within the sub-basins. (See Figure III.1-2[a] and Figure III.1-2[b] for a map of project locations and ecoregion subarea boundaries.)

Eight of the 18 basins listed in Table III.6-2 are located almost entirely within the Cadiz Valley and Chocolate Mountains ecoregion subarea (90% or more of the area of each of these basins is located in the ecoregion subarea, and combined they represent 74% of the total ecoregion subarea). These are sub-basin areas of the Arroyo Seco Valley, Calzona Valley, Chuckwalla Valley, Palo Verde Mesa, Palo Verde Valley, Quien Sabe Point Valley, Rice Valley, and Vidal Valley basins. Of the remaining 10 sub-basin areas, 5 have less than 10% of their total area within this ecoregion subarea (Amos Valley, Bristol Valley, East Salton Sea, Ogilby Valley, and Pinto Valley). These five sub-basin areas combined represent less than 1% of the ecoregion subarea.

About 6% of the sub-basin areas in the Cadiz Valley and Chocolate Mountains ecoregion subarea are disturbed (agriculture or developed areas). The Palo Verde Valley and Palo Verde Mesa are the most disturbed, with 92% and 21% of their areas already disturbed, respectively. Most of the disturbance is for agriculture (82%), and the Palo Verde Valley Basin receives imported water. Five of the sub-basins have no mapped disturbance: Bristol Valley, Chocolate Valley, East Salton Sea, Ogilby Valley, and Pinto Valley. A proposed aquifer storage and recovery project, the Cadiz Valley Water Project, is expected to produce billions of gallons of groundwater and storage space to bank surface water. The EIR for this project was certified by the Santa Margarita Water District (lead agency) in July 2012, and was approved by San Bernardino County in October 2012. The most significant renewable energy project development is in the Chuckwalla Valley, where more than 6,000 acres and over 800 megawatts (MW) of solar thermal and solar PV are either under construction or operational.

Within the Cadiz Valley and Chocolate Mountains ecoregion subarea, 10 of the 18 basins are partly or entirely within the Colorado River Aquifer, and 4 additional basins are possibly tributary to the river aquifer. Twelve of the basins within this ecoregion subarea are hydraulically connected, meaning that water may be exchanged between adjacent basins as subsurface flow, and one basin, Cadiz Valley, has a discharging playa.

The regional average annual precipitation recharge estimate for the Cadiz Valley and Chocolate Mountains ecoregion subarea is about 4,000 acre-feet/year (Figure III 6-7). This recharge is the total for areas within the ecoregion subarea, including mountain block areas between groundwater basins. However, this estimate of recharge excludes potential irrigation return flows and rainfall in watershed areas outside the overall general DRECP area. The runoff from these outside watershed areas, if any, could contribute recharge as either percolating runoff or subsurface inflow. Additional discussion of the rainfall recharge estimates appears in Section III.6.3.3.2. Groundwater inflow or outflow with adjacent ecoregion subareas would affect the overall water budget of the Cadiz Valley and Chocolate Mountains ecoregion subarea.

The groundwater storage capacity of the Cadiz Valley and Chocolate Mountain ecoregion subarea is approximately 43 million acre-feet (almost 19 acre-feet per acre [AF/Ac]), which was calculated by prorating the Bulletin 118 basin storage capacities on a per-area basis. Reported well yields range from 25 to 1,800 gpm and average 450 gpm; 4 of the 18 basins (22%) have no reported well-yield data. More than 900 wells with water-level data in the DWR data library are in this ecoregion subarea, and most are located in the Palo Verde Mesa (53%) and Palo Verde Valley (23%) basins.

Average TDS concentrations in the Cadiz Valley and Chocolate Mountains ecoregion subarea reportedly range from 300 mg/L to almost 150,000 mg/L. The predominant ions present in the groundwater include sodium, calcium, bicarbonate, chloride, and sulfate, and the concentrations of these ions can be high in some basins. In areas near playas, the groundwater is typically high in sodium and chloride. Significant concentrations of boron, fluoride, arsenic, and selenium are reportedly present in water extracted from some of the basins; uranium and radon concentrations in the Orocopia Valley are reported to be higher than allowable for drinking water standards (DWR Bulletin 118).

Table III.6-2
California Department of Water Resources Basins in the Cadiz Valley and Chocolate Mountains Ecoregion Subarea of the DRECP

Basin Number	Groundwater Basin	Total Basin Area (acres)'	Portion of Basin (Sub-Basin) in Ecoregion Subarea'		
			Sub-Basin Area	*Disturbed Sub-Basin Area*	*Existing Renewable Energy Projects Located in Sub-Basin'*
7-34	Amos Valley	129,900	3,300	100	0
7-37	Arroyo Seco Valley	256,500	256,500	2,200	0
7-8	Bristol Valley	496,600	100	0	0
7-7	Cadiz Valley	269,800	239,900	1,200	0
7-41	Calzona Valley	80,600	78,000	3,900	0
7-32	Chocolate Valley	129,100	63,400	0	0
7-5	Chuckwalla Valley	601,500	593,200	10,800	6,100
7-33	East Salton Sea	194,800	15,700	0	0
7-35	Ogilby Valley	133,200	500	0	0
7-31	Orocopia Valley	96,200	16,600	500	0
7-39	Palo Verde Mesa	225,000	225,000	47,700	200
7-38	Palo Verde Valley	73,000	72,800	66,800	0
7-6	Pinto Valley	182,400	2,100	0	0
7-40	Quien Sabe Point Valley	25,100	25,100	1,000	0
7-4	Rice Valley	188,100	186,900	1,000	0
7-42	Vidal Valley	137,700	127,700	1,600	0
7-3	Ward Valley	557,600	352,900	900	0
7-36	Yuma Valley	124,000	21,900	100	0

Groundwater basin areas were calculated using ArcGIS and the basin shapefile available from CDWR (http://www.water.ca.gov/groundwater/bulletin118/gwbasin_maps_descriptions.cfm). The calculated basin areas can be different than reported in the CDWR basin descriptions.
The basin area within each DRECP ecoregion subarea, herein referred to as the sub-basin, was determined by intersecting the CDWR groundwater basin shapefile with the DRECP ecoregion subarea boundary.
Reported acres of existing renewable energy projects having mapped locations within the sub-basin area. Note that the reported acres do not delineate between the renewable energy project footprint located within the CDWR basin boundary and portions of the footprint that might extend outside the basin boundary.
The area reported in Bulletin 118 is only 3,780 acres. Based on the map information provided by the CDWR, the acreage reported in Bulletin 118 appears to be wrong.
The following general rounding rules were applied to calculated values: values greater than 1,000 were rounded to the nearest 1,000; values less than 1,000 and greater than 100 were rounded to the nearest 100; values of 100 or less were rounded to the nearest 10, and therefore totals may not sum due to rounding. In cases where subtotals are provided, the subtotals and the totals are individually rounded. The totals are not a sum of the rounded subtotals; therefore the subtotals may not sum to the total within the table.

III.6.4.2 Imperial Borrego Valley Ecoregion Subarea

The Imperial Borrego Valley ecoregion subarea contains all or portions of 12 mapped groundwater basins totaling 2,170,000 acres. Table III.6-3 lists the basin names, total basin areas, and sub-basin areas. Additionally, Table III.6-3 shows sub-basin areas that are disturbed by either agriculture or other developed land uses, and the footprint for existing renewable energy projects, in acres, where mapped locations fall within the sub-basins. (See Figure III.1-2[a] and Figure III.1-2[b] for a map of project locations and ecoregion subarea boundaries.)

Six of the 12 basins listed in Table III.6-3 are almost entirely within the Imperial Borrego Valley ecoregion subarea, or at least 90% of each of these basins. These 6 sub-basins represent 71% of the Borrego Valley ecoregion subarea: Amos Valley, Borrego Valley, Coyote Wells Valley, Imperial Valley, Ocotillo–Clark Valley, and Ogilby Valley basins. Of the remaining 6, 2 sub-basins represent less than 10% of their total basin area: Chocolate Valley and Coachella Valley–Indio. These two sub-basins together represent less than 0.5% of the ecoregion subarea.

Almost 30% of the sub-basin areas in the Imperial Borrego Valley ecoregion subarea is disturbed land areas. Most of the disturbance is for agriculture (85%), and three basins (the Coyote Wells Valley, Imperial Valley, and Ocotillo–Clark Valley) receive imported water. The Imperial Valley is the most disturbed sub-basin, with 56% of its area disturbed. Only two sub-basins have little to no disturbance – Chocolate Valley and Vallecito-Carrizo Valley. The most significant renewable energy project development is in the Imperial Valley (8,500 acres), which includes some acreage in the West Salton Sea. Less acreage of existing renewable energy project development is in Borrego Valley and Coyote Wells Valley (fewer than 100 acres each).

Within the Imperial Borrego Valley ecoregion subarea all of the basins are hydraulically connected (groundwater may flow between the connected basins) and groundwater in some areas flows to the Salton Sea. Three of the 12 basins are partly or entirely within the Colorado River Aquifer, and one additional basin might be tributary to the Colorado River Aquifer.

Table III.6-3
California Department of Water Resources Basins in the Imperial Borrego Valley Ecoregion Subarea of the DRECP

Basin Number	Groundwater Basin	Total Basin Area (acres)'	Portion of Basin (Sub-Basin) in Ecoregion Subarea'		
			Sub-Basin Area	*Disturbed Sub-Basin Area*	*Existing Renewable Energy Projects Located in Sub-Basin*
7-34	Amos Valley	129,900	126,600	2,000	0
7-24	Borrego Valley	152,500	139,700	14,800	< 100
7-32	Chocolate Valley	129,100	8,800	0	0
7-21.01	Coachella Valley–Indio	297,000	1,000	300	0
7-29	Coyote Wells Valley	145,600	134,800	2,200	< 100
7-33	East Salton Sea	194,800	174,000	22,100	0
7-30	Imperial Valley	957,600	956,100	539,700	8,500
7-25	Ocotillo–Clark Valley	222,100	211,000	17,700	0
7-35	Ogilby Valley	133,200	132,500	2,900	0
7-28	Vallecito–Carrizo Valley	121,700	96,900	< 100	0
7-22	West Salton Sea	105,300	87,000	12,800	0
7-36	Yuma Valley	124,000	102,000	25,600	0

Groundwater basin areas were calculated using ArcGIS and the basin shapefile available from CDWR (http://www.water.ca.gov/groundwater/bulletin118/gwbasin_maps_descriptions.cfm). The calculated basin areas can be different than reported in the CDWR basin descriptions.
The basin area within each DRECP ecoregion subarea, herein referred to as the sub-basin, was determined by intersecting the CDWR groundwater basin shapefile with the DRECP ecoregion subarea boundary.
Reported acres of existing renewable energy projects having mapped locations within the sub-basin area. Note that the reported acres do not delineate between the renewable energy project footprint located within the CDWR basin boundary and portions of the footprint that might extend outside the basin boundary.
Groundwater storage capacity not reported for this basin in CDWR Bulletin 118.
The following general rounding rules were applied to calculated values: values greater than 1,000 were rounded to the nearest 1,000; values less than 1,000 and greater than 100 were rounded to the nearest 100; values of 100 or less were rounded to the nearest 10, and therefore totals may not sum due to rounding. In cases where subtotals are provided, the subtotals and the totals are individually rounded. The totals are not a sum of the rounded subtotals; therefore the subtotals may not sum to the total within the table.

The regional average annual precipitation recharge estimate for the Imperial Borrego Valley ecoregion subarea is less than 800 acre-feet/year (Figure III 6-7). This number is the total for areas within the ecoregion subarea, including mountain block areas between groundwater basins. However, this recharge estimate excludes potential irrigation return flows and rainfall in watershed areas located outside the DRECP area. The runoff from these outside watershed areas, if any, could contribute recharge as either percolating runoff or subsurface inflow. Additional discussion of the rainfall recharge estimates appears in

Section III.6.3.3.2. Groundwater inflow or outflow with adjacent ecoregion subareas would affect the overall water budget of the Imperial Borrego Valley ecoregion subarea.

Groundwater storage capacity of the Imperial Borrego Valley ecoregion subarea is reported for 11 of the 12 groundwater basins. Storage capacity for the West Salton Sea is not reported. The groundwater storage capacity of these 11 basins is approximately 38 million acre-feet (18 AF/Ac), which is an estimate calculated by prorating Bulletin 118 basin storage capacities on a per-area basis. Reported well yields range from 40 to 1,880 gpm; five 5 of the 12 basins have no reported well-yield data. Two of the basins (Imperial Valley and West Salton Sea) contain geothermal extractions. More than 500 wells with water-level data in the DWR Water Data Library are in this ecoregion subarea. Most of the wells are found in the Yuma Valley (59%), Coyote Wells Valley (13%), Imperial Valley (12%), and Ogilby Valley (10%) basins.

Average TDS concentrations in the Imperial Borrego Valley ecoregion subarea basins reportedly range from 680 to 5,800 mg/L. Most of the basins have high TDS values, and the water is marginal to poor for domestic use. The predominant ions present in the groundwater include sodium, chloride, and sulfate, and the concentrations of these ions can be high. There reportedly are also significant concentrations of boron, fluoride, and nitrate in some basins; the Imperial Valley groundwater quality is also degraded by recharge from the New River.

III.6.4.3 Kingston and Funeral Mountains Ecoregion Subarea

The Kingston and Funeral Mountains ecoregion subarea contains all or portions of 15 mapped groundwater basins, with a combined area totaling 1,490,000 acres. Table III.6-4 lists the basin names, total basin areas, and sub-basin areas within this ecoregion subarea. Additionally, Table III.6-4 reports the sub-basin areas that are disturbed by either agriculture or other developed land uses, and the footprint of existing renewable energy projects, in acres, where mapped locations fall within the sub-basins. (See Figure III.1-2[a] and Figure III.1-2[b] for a map of project locations and ecoregion subarea boundaries.)

Table III.6-4
Department of Water Resources Basins in the Kingston and Funeral Mountains Ecoregion Subarea of the DRECP

Basin Number	Groundwater Basin	Total Basin Area (acres)	Portion of Basin (Sub-Basin) in Ecoregion Subarea		
			Sub-Basin Area	*Developed Sub-Basin Area*	*Existing Renewable Energy Projects Located in Sub-Basin*
6-79	California Valley	58,100	58,100	< 100	0
6-18	Death Valley	919,800	43,500	400	0
6-85	Gold Valley	3,200	3,200	0	0
6-84	Greenwater Valley	59,800	59,800	600	0
6-30	Ivanpah Valley	197,900	195,700	800	3,500
6-31	Kelso Valley	254,600	115,300	100	0
6-21	Lower Kingston Valley	239,600	141,700	0	0
6-29	Mesquite Valley	88,100	88,000	200	0
6-20	Middle Amargosa Valley	389,500	389,400	3,500	0
6-28	Pahrump Valley	92,800	92,800	100	0
6-86	Rhodes Hill Area	15,600	13,500	0	0
6-23	Riggs Valley	87,500	9,800	0	0
6-34	Silver Lake Valley	35,200	2,900	0	0
6-33	Soda Lake Valley	379,800	100,000	0	0
6-22	Upper Kingston Valley	176,700	176,700	800	0

Groundwater basin areas were calculated using ArcGIS and the basin shapefile available from CDWR (http://www.water.ca.gov/groundwater/bulletin118/gwbasin_maps_descriptions.cfm). The calculated basin areas can be different than reported in the CDWR basin descriptions.
The basin area within each DRECP ecoregion subarea, herein referred to as the sub-basin, was determined by intersecting the CDWR groundwater basin shapefile with the DRECP ecoregion subarea boundary.
Groundwater storage capacity not reported for these basins in CDWR Bulletin 118.
Reported acres of existing renewable energy projects having mapped locations within the sub-basin area. Note that the reported acres do not delineate between the renewable energy project footprint located within the CDWR basin boundary and portions of the footprint that might extend outside the basin boundary.
The following general rounding rules were applied to calculated values: values greater than 1,000 were rounded to the nearest 1,000; values less than 1,000 and greater than 100 were rounded to the nearest 100; values of 100 or less were rounded to the nearest 10, and therefore totals may not sum due to rounding. In cases where subtotals are provided, the subtotals and the totals are individually rounded. The totals are not a sum of the rounded subtotals; therefore the subtotals may not sum to the total within the table.

Eight of the 15 basins listed in Table III.6-4 are almost entirely within the Kingston and Funeral Mountains ecoregion subarea (90% or more of their basin areas are located in the ecoregion subarea). These 8 sub-basins represent 43% of the Funeral Mountains ecoregion subarea. These are sub-basins of the California Valley, Gold Valley, Greenwater Valley, Ivanpah Valley, Mesquite Valley, Middle Amargosa Valley, Pahrump Valley, and Upper Kingston Valley basins. Of the remaining 7 sub-basins, 2 represent less than 10% of their basins (Death Valley and Silver Lake Valley). These seven sub-basins together represent 17% of the ecoregion subarea.

Less than 1% of the sub-basin areas in the Kingston and Funeral Mountains ecoregion subarea are disturbed. There is no agricultural disturbance, and no basins receive imported water. Six of the 15 sub-basins have no mapped disturbance: Gold Valley, Lower Kingston Valley, Rhodes Hill Area, Riggs Valley, Silver Lake Valley, and Soda Valley. The only existing renewable energy project development is in the Ivanpah Valley (3,500 acres).

All of the basins within the Kingston and Funeral Mountains ecoregion subarea are hydraulically connected (groundwater may flow between the connected basins), and four basins have discharging playas: Death Valley, Mesquite Valley, Middle Amargosa Valley, and Soda Lake Valley basins. Generally, groundwater flow in this region has two components: deep groundwater flow associated with the regional carbonate aquifer system, and flow in the overlying alluvial basins from the Mojave River drainage area north into the Amargosa/Death Valley area. Both of these flow paths terminate in the groundwater sink that is Death Valley. The Amargosa River is located in the Lower Kingston Valley and Middle Amargosa Valley basins, and much of the flow in the river is from groundwater underflow that is forced to the surface from shallow bedrock or other relatively impermeable barriers (Andy Zdon & Associates 2014). The river has been federally designated a Wild and Scenic River and there are concerns that groundwater extraction by projects may deprive the river of flow needed to sustain the resources protected by this designation. This ecoregion subarea is hydraulically connected to adjacent nearby sensitive areas in the state of Nevada (Ash Meadows National Wildlife Refuge and the Devil's Hole unit of Death Valley National Park).

The regional average annual precipitation recharge estimate for the Kingston and Funeral Mountains ecoregion subarea is about 11,000 acre-feet/year (Figure III 6-7). This number is the total for recharge within the ecoregion subarea, including mountain block areas between groundwater basins. However, this estimate excludes precipitation in watershed areas outside the DRECP area. The runoff from these outside watershed areas, if any, could contribute recharge as either percolating runoff or subsurface inflow. Discussion of the rainfall recharge estimates appears in Section III.6.3.3.2. Additionally, the Kingston and Funeral Mountains ecoregion subarea receives flow from a regional carbonate aquifer adjoining areas in Nevada, including the Upper Amargosa Valley and the Pahrump Valley. This component of recharge is not included in the above estimate and would affect the overall water budget of the Kingston and Funeral Mountains ecoregion subarea.

Groundwater storage capacity is reported for 11 of the 15 groundwater basins in the Kingston and Funeral Mountains ecoregion subarea. The groundwater storage capacity of these 11 basins is approximately 21 million acre-feet (15 AF/Ac), which was calculated by prorating Bulletin 118 basin storage capacities on a per-area basis. Reported well yields range from 24 to 2,500 gpm; eight of the 15 basins have no reported well-yield data. More than 100 wells with water level data reported in the CDWR Water Data Library are in this ecoregion subarea, and most are in only three 3 of the 15 basins: Middle Amargosa Valley (51%), Ivanpah Valley (25%), and Pahrump Valley.

Average TDS concentrations in the Kingston and Funeral Mountains ecoregion subarea reportedly range from 340 to 6,963 mg/L. Predominant ions in the groundwater include sodium, bicarbonate, calcium, magnesium, and sulfate, and the concentrations of these ions can be high in some basins. In areas near playa lakes, the groundwater is typically high in sodium and chloride. There are also reportedly significant concentrations of fluoride, boron, and chloride in some basins.

III.6.4.4 Mojave and Silurian Valley Ecoregion Subarea

The Mojave and Silurian Valley ecoregion subarea contains all or portions of 28 mapped groundwater basins, with a combined area totaling 1,784,000 acres. Table III.6-5 lists the basin names, total basin areas, and sub-basin areas within this ecoregion subarea. Additionally, Table III.6-5 reports the sub-basin areas that are disturbed by either agriculture or other developed land uses, and the footprint of existing renewable energy projects, in acres, where mapped locations fall within the sub-basins. (See Figure III.1-2[a] and Figure III.1-2[b] for a map of project locations and ecoregion subarea boundaries.)

Fourteen of the 28 basins listed in Table III.6-5 are almost entirely within the Mojave and Silurian Valley ecoregion subarea (90% or more of the area of each of these basins). These 14 sub-basins represent 32% of the Mojave and Silurian Valley ecoregion subarea. These are sub-basins of the Avawatz Valley, Bicycle Valley, Coyote Lake Valley, Cronise Valley, Denning Spring Valley, Goldstone Valley, Grass Valley, Langford Valley–Langford Well Lake, Langford Valley–Irwin, Leach Valley, Pilot Knob Valley, Red Pass Valley, Silver Lake Valley, Superior Valley basins. Of the remaining 14 sub-basins, seven represent less than 10% of their basins: Cady Fault Area, Death Valley, Fremont Valley, Harper Valley, Lavic Valley, Owl Lake Valley, and Searles Valley. These 7 sub-basins together represent about 3% of the ecoregion subarea.

Less than 2% of the sub-basin areas in the Mojave and Silurian Valley ecoregion subarea is disturbed. Agriculture represents 28% of the disturbed land area, and only one of the basins (Lower Mojave River Valley) receives imported water. Langford Valley–Irwin is the most disturbed, with 30% of its sub-basin disturbed. Eleven sub-basins have no mapped disturbance, and there is no renewable energy development.

Table III.6-5
California Department of Water Resources Basins in the Mojave and Silurian Valley Ecoregion Subarea of the DRECP

Basin Number	Groundwater Basin	Total Basin Area (acres)'	Portion of Basin (Sub-Basin) in Ecoregion Subarea'		
			Sub-Basin Area	*Disturbed Sub-Basin Area*	*Existing Renewable Energy Projects Located in Sub-Basin*
6-26	Avawatz Valley	27,600	27,600	0	0
6-25	Bicycle Valley	89,400	89,400	1,600	0
6-90	Cady Fault Area	7,900	600	0	0
6-38	Caves Canyon Valley	72,900	54,800	300	0
6-37	Coyote Lake Valley	88,000	88,000	600	0
6-35	Cronise Valley	126,200	126,200	0	0
6-50	Cuddeback Valley	94,800	18,800	200	0
6-18	Death Valley	919,800	41,800	0	0
6-78	Denning Spring Valley	7,200	7,200	0	0
6-46	Fremont Valley	335,000	17,700	100	0
6-48	Goldstone Valley	28,100	28,100	300	0
6-77	Grass Valley	10,000	10,000	0	0
6-47	Harper Valley	409,200	7,800	< 100	0
6-31	Kelso Valley	254,600	129,000	< 100	0
6-36.01	Langford Valley–Langford Well Lake	19,300	19,300	600	0
6-36.02	Langford Valley–Irwin	10,500	10,500	3,100	0
7-14	Lavic Valley	102,200	4,300	0	0
6-27	Leach Valley	60,900	60,900	300	0
6-21	Lower Kingston Valley	239,600	97,900	0	0
6-40	Lower Mojave Valley	285,300	200,100	17,300	0
6-88	Owl Lake Valley	22,200	600	0	0
6-51	Pilot Knob Valley	138,500	135,900	300	0
6-24	Red Pass Valley	96,200	96,200	200	0
6-23	Riggs Valley	87,500	77,700	0	0
6-52	Searles Valley	196,900	14,700	< 100	0
6-34	Silver Lake Valley	35,200	32,200	0	0

**Table III.6-5
California Department of Water Resources Basins in the
Mojave and Silurian Valley Ecoregion Subarea of the DRECP**

Basin Number	Groundwater Basin	Total Basin Area (acres)'	Portion of Basin (Sub-Basin) in Ecoregion Subarea'		
			Sub-Basin Area	*Disturbed Sub-Basin Area*	*Existing Renewable Energy Projects Located in Sub-Basin*
6-33	Soda Lake Valley	379,800	266,200	600	0
6-49	Superior Valley	120,200	120,200	300	0

Groundwater basin areas were calculated using ArcGIS and the basin shapefile available from CDWR (http://www.water.ca.gov/groundwater/bulletin118/gwbasin_maps_descriptions.cfm). The calculated basin areas can be different than reported in the CDWR basin descriptions.

The basin area within each DRECP ecoregion subarea, herein referred to as the sub-basin, was determined by intersecting the CDWR groundwater basin shapefile with the DRECP ecoregion subarea boundary.

Reported acres of existing renewable energy projects having mapped locations within the sub-basin area. Note that the reported acres do not delineate between the renewable energy project footprint located within the CDWR basin boundary and portions of the footprint that might extend outside the basin boundary.

Groundwater storage capacity not reported for these basins in CDWR Bulletin 118.

The following general rounding rules were applied to calculated values: values greater than 1,000 were rounded to the nearest 1,000; values less than 1,000 and greater than 100 were rounded to the nearest 100; values of 100 or less were rounded to the nearest 10, and therefore totals may not sum due to rounding. In cases where subtotals are provided, the subtotals and the totals are individually rounded. The totals are not a sum of the rounded subtotals; therefore the subtotals may not sum to the total within the table.

Thirteen of the basins within the Mojave and Silurian Valley ecoregion subarea are hydraulically connected (groundwater may flow between the connected basins), and 4 basins have discharging playas: Death Valley, Fremont Valley, Searles Valley, and Soda Lake Valley. The Amargosa River is located in the Lower Kingston Valley and Death Valley basins, and the river has been designated a Wild and Scenic River. There are concerns that groundwater extraction by projects may deprive the river of flow needed to sustain the resources protected by this designation.

The regional average annual precipitation recharge estimate for the Mojave and Silurian Valley ecoregion subarea is less than 9,000 acre-feet/year (Figure III 6-7). This number is the total for areas within the ecoregion subarea, including mountain block areas between groundwater basins. However, this estimate excludes precipitation in watershed areas outside the DRECP area. The runoff from these outside watershed areas, if any, could contribute recharge as either percolating runoff or subsurface inflow. Discussion of the rainfall recharge estimates appears in Section III.6.3.3.2. Groundwater inflow and outflow with adjacent ecoregion subareas would affect the overall water budget of the Mojave and Silurian Valley ecoregion subarea.

Groundwater storage capacity is reported for 24 of the 28 groundwater basins in the Mojave and Silurian Valley ecoregion subarea. The groundwater storage capacity of these 24 basins is approximately 40 million acre-feet (23 AF/Ac), which was calculated by prorating Bulletin 118 basin storage capacities on a per-area basis. Reported well yields range from 80 to 1,000 gpm; 14 of the 28 basins have no reported well-yield data. More than 750 wells with water-level data in the DWR Water Data Library are in this ecoregion subarea, and most of these wells are found in Lower Mojave River Valley (70%) and Langford Valley–Irwin (12%).

Average TDS concentrations in the Mojave and Silurian Valley ecoregion subarea range from 418 to 6,963 mg/L. The predominate ions present in the groundwater include sodium, calcium, chloride, sulfate, and bicarbonate. There are also significant concentrations of boron, fluoride, iron, and nitrate in some groundwater basins. The Lower Mojave River Valley Basin contains nine LUST sites and one Superfund site contaminated with TCE, MTBE, BTEX, and other petroleum-based compounds.

III.6.4.5 Owens River Valley Ecoregion Subarea

The Owens River Valley ecoregion subarea contains all or portions of two mapped DWR groundwater basins; 381,000 acres are within this ecoregion subarea. Table III.6-6 lists the basin names, total basin areas, and sub-basin areas within this ecoregion subarea. Additionally, Table III.6-6 reports the sub-basin areas that are disturbed by either agriculture or other developed land uses, and the footprint of existing renewable energy projects, in acres, where mapped locations fall within the sub-basins. (See Figure III.1-2[a] and Figure III.1-2[b] for a map of project locations and ecoregion subarea boundaries.)

The Owens River Valley ecoregion subarea contains a portion of only two DWR groundwater basins: the Owens Valley (53%) and Rose Valley (79%). Less than 2% of these sub-basins are disturbed, and there is no renewable energy development. Neither basin receives imported water. Both basins are hydraulically connected, and the Owens Valley Basin has a discharging playa.

Table III.6-6
California Department of Water Resources Basins in the Owens River Valley Ecoregion Subarea of the DRECP

Basin Number	Groundwater Basin	Total Basin Area (acres)′	Portion of Basin (Sub-Basin) in Ecoregion Subarea′		
			Sub-Basin Area	*Disturbed Sub-Basin Area*	*Existing Renewable Energy Projects Located in Sub-Basin*
6-12	Owens Valley	660,700	347,200	5,900	0
6-56	Rose Valley	42,500	33,700	1,000	0

Groundwater basin areas were calculated using ArcGIS and the basin shapefile available from CDWR (http://www.water.ca.gov/groundwater/bulletin118/gwbasin_maps_descriptions.cfm). The calculated basin areas can be different than reported in the CDWR basin descriptions.
The basin area within each DRECP ecoregion subarea, herein referred to as the sub-basin, was determined by intersecting the CDWR groundwater basin shapefile with the DRECP ecoregion subarea boundary.
Reported acres of existing renewable energy projects having mapped locations within the sub-basin area. Note that the reported acres do not delineate between the renewable energy project footprint located within the CDWR basin boundary and portions of the footprint that might extend outside the basin boundary.
The following general rounding rules were applied to calculated values: values greater than 1,000 were rounded to the nearest 1,000; values less than 1,000 and greater than 100 were rounded to the nearest 100; values of 100 or less were rounded to the nearest 10, and therefore totals may not sum due to rounding. In cases where subtotals are provided, the subtotals and the totals are individually rounded. The totals are not a sum of the rounded subtotals; therefore the subtotals may not sum to the total within the table.

The regional average annual precipitation recharge estimate for the Owens River Valley ecoregion subarea totals less than 500 acre-feet/year (Figure III 6-7). This relatively small number is for basin boundaries within the DRECP area only, which in the Owens Valley includes only the southern part of the valley floor. As noted in Section III.6.3.3.2, other factors contribute to recharge in groundwater basins within this ecoregion subarea. The Owens Valley Basin receives substantial runoff and groundwater inflow from the Sierra Nevada Mountains, which adjoin the western edge of the basin, and from the northern part of the valley floor, but neither of these areas is within the DRECP area. The recharge from these excluded areas is therefore not included in the rainfall recharge estimate. Recharge in the Owens Valley is therefore likely to be substantially greater than represented in the estimate. A comprehensive study of groundwater conditions in the Owens Valley estimated total recharge at about 190,000 AF/year, of which rainfall recharge on the valley floor contributed only 2,000 AF/year (Danskin 1998).

The groundwater storage capacity of the Owens River Valley ecoregion subarea is almost 18 million acre-feet (46 AF/Ac), which was calculated by prorating Bulletin 118 basin storage capacities on a per-area basis. Reported well yields range from 1,870 to 2,700 gpm. Almost 90 wells with water-level data in the DWR Water Data Library are in this ecoregion subarea, and most of these wells are in the Owens Valley Basin (93%).

Average TDS concentrations in the Owens River Valley ecoregion subarea range from 130 to 350 mg/L, except in areas beneath Owens Lake where groundwater can contain concentrations up to 450,000 mg/L. The predominate ions present in the groundwater include sodium bicarbonate and calcium bicarbonate. There are significant concentrations of boron and fluoride in groundwater produced in some wells.

III.6.4.6 Panamint Death Valley Ecoregion Subarea

The Panamint Death Valley ecoregion subarea contains all or portions of 17 mapped DWR groundwater basins, with a combined area of 1,391,000 acres. Table III.6-7 lists the basin names, total basin areas, and sub-basin areas. Additionally, Table III.6-7 reports the sub-basin areas that are disturbed by either agriculture or other developed land uses, and the footprint of existing renewable energy projects, in acres, where mapped locations fall within the sub-basins (See Figure III.1-2[a] and Figure III.1-2[b] for a map of project locations and ecoregion subarea boundaries.)

Seven of the 17 basins listed in Table III.6-7 are almost entirely within the Panamint Death Valley ecoregion subarea (90% or more of the area of each basin is located in the ecoregion subarea). These 7 sub-basins represent 29% of the Panamint Death Valley ecoregion subarea. These are sub-basins of the Brown Mountain Valley, Lost Lake Valley, Owl Lake Valley, Panamint Valley, Searles Valley, Spring Canyon Valley, and Wingate Valley basins. Of the remaining 10 sub-basins, 6 represent less than 10% of their basins: Fremont Valley, Harrisburg Flats, Indian Wells Valley, Leach Valley, Pilot Knob Valley, and Wildrose Canyon Valley basins. These 6 sub-basins together represent less than 2% of the ecoregion subarea.

In the Panamint Death Valley ecoregion subarea, less than 2% of the sub-basin areas are disturbed, and none of the area is disturbed by agriculture; no basins receive imported water. Searles Valley is the most disturbed sub-basin (14% of the sub-basin is disturbed). Ten of the sub-basins have no disturbance: Brown Mountain Valley, Butte Valley, Fremont Valley, Harrisburg Flats, Leach Valley, Lost Lake Valley, Owl Lake Valley, Rhodes Hill Area, Spring Canyon Valley, and Wildrose Canyon. There is no renewable energy development.

**Table III.6-7
California Department of Water Resources Basins in the
Panamint Death Valley Ecoregion Subarea of the DRECP**

Basin Number	Groundwater Basin	Total Basin Area (acres)′	Portion of Basin (Sub-Basin) in Ecoregion Subarea′		
			Sub-Basin Area	*Disturbed Sub-Basin Area*	*Existing Renewable Energy Projects Located in Sub-Basin*
6-76	Brown Mountain Valley	21,700	21,700	0	0
6-81	Butte Valley	8,800	7,600	0	0
6-18	Death Valley	919,800	790,600	600	0
6-46	Fremont Valley	335,000	200	0	0
6-74	Harrisburg Flats	24,900	600	0	0
6-54	Indian Wells Valley	381,500	19,500	< 100	0
6-27	Leach Valley	60,900	200	0	0
6-71	Lost Lake Valley	23,200	23,200	0	0
6-88	Owl Lake Valley	22,200	21,700	0	0
6-58	Panamint Valley	259,100	240,000	100	0
6-51	Pilot Knob Valley	138,500	2,600	< 100	0
6-86	Rhodes Hill Area	15,600	2,000	0	0
6-53	Salt Wells Valley	29,500	6,300	100	0
6-52	Searles Valley	196,900	178,500	25,400	0
6-82	Spring Canyon Valley	4,800	4,800	0	0
6-75	Wildrose Canyon	5,100	< 100	0	0
6-19	Wingate Valley	71,200	71,200	100	0

Groundwater basin areas were calculated using ArcGIS and the basin shapefile available from CDWR (http://www.water.ca.gov/groundwater/bulletin118/gwbasin_maps_descriptions.cfm). The calculated basin areas can be different than reported in the CDWR basin descriptions.
The basin area within each DRECP ecoregion subarea, herein referred to as the sub-basin, was determined by intersecting the CDWR groundwater basin shapefile with the DRECP ecoregion subarea boundary.
Reported acres of existing renewable energy projects having mapped locations within the sub-basin area. Note that the reported acres do not delineate between the renewable energy project footprint located within the CDWR basin boundary and portions of the footprint that might extend outside the basin boundary.
Groundwater storage capacity not reported for these basins in CDWR Bulletin 118.
The following general rounding rules were applied to calculated values: values greater than 1,000 were rounded to the nearest 1,000; values less than 1,000 and greater than 100 were rounded to the nearest 100; values of 100 or less were rounded to the nearest 10, and therefore totals may not sum due to rounding. In cases where subtotals are provided, the subtotals and the totals are individually rounded. The totals are not a sum of the rounded subtotals; therefore the subtotals may not sum to the total within the table.

In the Panamint Death Valley ecoregion subarea, 10 basins are hydraulically connected (groundwater may flow between the connected basins), and 4 basins contain at least one discharging playa: Death Valley, Brown Mountain Valley, Fremont Valley, and Searles Valley. The Amargosa River is located in the Death Valley basin, and the river has been designated a Wild and Scenic River. There are concerns that groundwater extraction may deprive the river of flow needed to sustain the resources protected by this designation.

The regional average annual precipitation recharge estimate for the Panamint Death Valley ecoregion subarea totals about 6,000 acre-feet/year (Figure III 6-7). This number is the total for areas within the Panamint Death Valley ecoregion subarea, including mountain blocks between basins. However, this estimate excludes rainfall in watershed areas located outside the DRECP area. The runoff from these outside watershed areas, if any, could contribute recharge as either percolating runoff or subsurface inflow. A discussion of the rainfall recharge estimates appears in Section III.6.3.3.2. Additionally, the recharge estimate excludes groundwater inflow from the regional carbonate aquifer from Middle Amargosa Valley in the Kingston and Funeral Mountains ecoregion subarea.

Groundwater storage capacity is reported for 8 of the 17 groundwater basins in this ecoregion subarea. The groundwater storage capacity of these 8 basins is approximately 15 million acre-feet (12 AF/Ac), which was calculated by prorating Bulletin 118 basin storage capacities on a per-area basis. Reported well yields range from 30 to 815 gpm; 12 of the 16 basins have no reported well-yield data. More than 150 wells with water-level data in the DWR Water Data Library are in this ecoregion subarea, with most of the wells in the Searles Valley (74%) and Death Valley (19%) basins.

Average TDS concentrations in the Panamint Death Valley ecoregion subarea range from 360 to 21,500 mg/L. The predominant ions present in the groundwater include sodium, bicarbonate, calcium, sulfate, and chloride. There are also significant concentrations of boron, fluoride, nitrate, and arsenic in water from some of these basins. In the Indian Wells Valley, groundwater pumping has caused relatively poor quality shallow groundwater to leak down and negatively impact water quality in the deeper aquifer (DWR Bulletin 118).

III.6.4.7 Pinto Lucerne Valley and Eastern Slopes Ecoregion Subarea

The Pinto Lucerne Valley and Eastern Slopes ecoregion subarea contains all or portions of 30 DWR mapped groundwater basins, of which 1,268,000 acres are within this ecoregion subarea. Table III.6-8 lists the basin names, total basin areas, and sub-basin areas within this ecoregion subarea. Additionally, Table III.6-8 reports the sub-basins that are disturbed by either agriculture or other developed land uses, and the footprint of existing renewable energy projects, in acres, where mapped locations fall within the sub-basins. (See Figure III.1-2[a] and Figure III.1-2[b] for a map of project locations and ecoregion subarea boundaries.)

Table III.6-8
California Department of Water Resources Basins in the Pinto Lucerne Valley and Eastern Slopes Ecoregion Subarea of the DRECP

Basin Number	Groundwater Basin	Total Basin Area (acres)ʹ	Portion of Basin (Sub-Basin) in Ecoregion Subareaʹ		
			Sub-Basin Area	*Disturbed Sub-Basin Area*	*Existing Renewable Energy Projects Located in Sub-Basin*
7-16	Ames Valley	108,400	108,400	7,500	0
7-15	Bessemer Valley	39,000	39,000	< 100	0
7-8	Bristol Valley	496,600	15,500	0	0
7-7	Cadiz Valley	269,800	100	0	0
7-5	Chuckwalla Valley	601,500	8,300	400	0
7-21.02	Coachella Valley–Mission Creek	48,500	800	0	0
7-11	Copper Mountain Valley	30,300	30,300	4,400	1,500
7-9	Dale Valley	212,400	123,000	500	0
7-13.01	Deadman Valley–Deadman Lake	89,000	87,800	400	0
7-13.02	Deadman Valley–Surprise Spring	29,200	29,200	0	0
7-53	Hexie Mountain Area	11,100	11,100	< 100	0
7-50	Iron Ridge Area	5,200	5,200		0
7-18.01	Johnson Valley–Soggy Lake	77,200	77,000	1,000	0
7-18.02	Johnson Valley–Upper Johnson Valley	34,800	34,800	0	0
7-62	Joshua Tree	27,200	27,200	2,400	0
6-89	Kane Wash Area	5,900	5,900	< 100	0
7-14	Lavic Valley	102,200	8,000	0	0
7-51	Lost Horse Valley	17,300	16,900	< 100	0
6-40	Lower Mojave River Valley	285,300	15,300	< 100	0
7-19	Lucerne Valley	147,300	146,700	8,800	0
7-17	Means Valley	14,900	14,900	< 100	0
7-41	Middle Mojave River Valley	211,200	57,300	300	0
7-20	Morongo Valley	7,200	7,200	4,400	0
7-31	Orocopia Valley	96,200	800	< 100	0

Table III.6-8
California Department of Water Resources Basins in the Pinto Lucerne Valley and Eastern Slopes Ecoregion Subarea of the DRECP

Basin Number	Groundwater Basin	Total Basin Area (acres)′	Portion of Basin (Sub-Basin) in Ecoregion Subarea′		
			Sub-Basin Area	*Disturbed Sub-Basin Area*	*Existing Renewable Energy Projects Located in Sub-Basin*
7-6	Pinto Valley	182,400	170,100	< 100	0
7-49	Pipes Canyon Fault Valley	3,400	2,800	300	0
7-52	Pleasant Valley	9,600	9,600	0	0
7-10	Twentynine Palms Valley	62,200	62,200	7,200	200
6-42	Upper Mojave River Valley	412,500	129,200	31,000	< 100
7-12	Warren Valley	23,700	23,400	7,500	0

Groundwater basin areas were calculated using ArcGIS and the basin shapefile available from CDWR (http://www.water.ca.gov/groundwater/bulletin118/gwbasin_maps_descriptions.cfm). The calculated basin areas can be different than reported in the CDWR basin descriptions.
The basin area within each DRECP ecoregion subarea, herein referred to as the sub-basin, was determined by intersecting the CDWR groundwater basin shapefile with the DRECP ecoregion subarea boundary.
Reported acres of existing renewable energy projects having mapped locations within the sub-basin area. Note that the reported acres do not delineate between the renewable energy project footprint located within the CDWR basin boundary and portions of the footprint that might extend outside the basin boundary.
Groundwater storage capacity not reported for these basins in CDWR Bulletin 118.
The following general rounding rules were applied to calculated values: values greater than 1,000 were rounded to the nearest 1,000; values less than 1,000 and greater than 100 were rounded to the nearest 100; values of 100 or less were rounded to the nearest 10, and therefore totals may not sum due to rounding. In cases where subtotals are provided, the subtotals and the totals are individually rounded. The totals are not a sum of the rounded subtotals; therefore the subtotals may not sum to the total within the table.

Nineteen of the 30 basins listed in Table III.6-8 are almost entirely within the Pinto Lucerne Valley and Eastern Slopes ecoregion subarea. 90% or more of the area of each of these basins is within the ecoregion subarea. These 19 sub-basins represent 39% of the Pinto Lucerne Valley and Eastern Slopes ecoregion subarea. Of the remaining 11 sub-basins, 7 represent less than 10% of their basin: Bristol Valley, Cadiz Valley, Chuckwalla Valley, Coachella Valley–Mission Creek, Lavic Valley, Lower Mojave River Valley, and Orocopia Valley. These 7 sub-basins together represent less than 3% of the ecoregion subarea.

In the Pinto Lucerne Valley and Eastern Slopes ecoregion subarea, 6% of the sub-basin areas are disturbed and only 4% of the disturbed area is for agriculture. Four of the 30 basins receive imported water: Lower Mojave River Valley, Middle Mojave River Valley, Upper Mojave River Valley, and Warren Valley basins. The Morongo Valley, Upper Mojave

River Valley, Warren Valley and Copper Valley sub-basins are the most disturbed, with from 15% to 61% of their area disturbed. There are about 1,700 acres of renewable energy project development, with most of it (88%) located in the Copper Mountain Valley basin.

Twenty basins in the Pinto Lucerne Valley and Eastern Slopes ecoregion subarea are hydraulically connected (groundwater may flow between the connected basins), and only four basins have discharging playas: Ames Valley, Bristol Valley, Cadiz Valley, and Dale Valley. Two basins partly or entirely overlie the Colorado River Aquifer, and an additional two basins are possibly tributary to the Colorado River Aquifer.

The regional average annual precipitation recharge estimate in the Pinto Lucerne Valley and Eastern Slopes ecoregion subarea ranges from 27,000 to 32,500 acre-feet/year (Figure III 6-7). This number is the total for areas within the ecoregion subarea, including mountain blocks between basins and parts of the adjacent San Bernardino–San Gorgonio Mountains. Annual precipitation exceeds 20 inches per year near these mountain summits, and other basins within the DRECP area might not include similar recharge generating mountain areas. Therefore, recharge in basin areas adjacent to these mountains could contribute recharge as either percolating runoff or subsurface inflow. A discussion of the rainfall recharge estimates appears in Section III.6.3.3.2. Groundwater inflow or outflow with adjacent ecoregion subareas would affect the overall water budget of the Pinto Lucerne Valley and Easter Slopes ecoregion subarea.

Groundwater storage capacity is reported for 23 of the 30 groundwater basins in the Pinto Lucerne Valley and Eastern Slopes ecoregion subarea. The groundwater storage capacity of these 23 basins is approximately 23 million acre-feet (about 20 AF/Ac), which was calculated by prorating Bulletin 118 basin storage capacities on a per-area basis. Reported well yields range from 60 to 3,000 gpm; 10 of the 30 basins have no reported well-yield data. More than 1,500 wells with water-level data in the DWR Water Data Library are in this ecoregion subarea, and most of the wells are found in only two of the 30 basins. The monitoring wells with data are in the Upper Mojave River Valley (39%) and Lucerne Valley (27%) basins. Bulletin 118 reports show that Lucerne Valley wells have recorded significant water level declines since the 1950s, which have resulted in measured subsidence.

Average TDS concentrations in the Pinto Lucerne Valley and Eastern Slopes ecoregion subarea reportedly range from 160 mg/L to almost 53,500 mg/L. The predominant ions in the groundwater include sodium, bicarbonate, calcium, chloride, sulfate, and manganese. There are also significant concentrations of fluoride, boron, nitrate, and iron; the Orocopia Valley reports uranium and radon concentrations that are higher than allowed in drinking water standards (DWR Bulletin 118).

The Lower Mojave River Valley and Upper Mojave River Valley contain 10 LUST sites and two Superfund sites contaminated with TCE, MTBE, BTEX, and other petroleum-based compounds. The Middle Mojave River Valley Basin also contains high concentrations of volatile organic compounds and salts due to irrigation with effluent and leaching from a landfill.

III.6.4.8 Piute Valley and Sacramento Mountains Ecoregion Subarea

The Piute Valley and Sacramento Mountains ecoregion subarea contains all or portions of seven mapped groundwater basins, of which 589,000 acres are in this ecoregion subarea. Table III.6-9 lists the basin names, total basin areas, and sub-basins. Additionally, Table III.6-9 shows sub-basins that are disturbed by either agriculture or other developed land uses, and the footprint of existing renewable energy projects, in acres, where mapped locations fall within the sub-basins. (See Figure III.1-2[a] and Figure III.1-2[b] for a map of project locations and ecoregion subarea boundaries.)

Two of the seven basins listed in Table III.6-9 are almost entirely within the Piute Valley and Sacramento Mountains ecoregion subarea (90% or more of their total basin area is within this ecoregion subarea). These two sub-basins represent 33% of the Piute Valley and Sacramento Mountains ecoregion subarea. These are sub-basins of the Chemehuevi Valley and Needles Valley. Of the remaining 5 sub-basins, 3 represent less than 10% of their total basin areas: Calzona Valley, Rice Valley, and Vidal Valley basins. These 3 sub-basins together represent less than 2% of the ecoregion subarea.

Table III.6-9
California Department of Water Resources Basins in the Piute Valley and Sacramento Mountains Ecoregion Subarea of the DRECP

Basin Number	Groundwater Basin	Total Basin Area (acres)′	Portion of Basin (Sub-Basin) in Ecoregion Subarea′		
			Sub-Basin Area	*Disturbed Sub-Basin Area*	*Existing Renewable Energy Projects Located in Sub-Basin*
7-41	Calzona Valley	80,600	2,500	0	0
7-43	Chemehuevi Valley	272,100	272,000	1,300	0
7-44	Needles Valley	87,900	86,100	8,200	0
7-45	Piute Valley	175,100	110,700	1,400	0
7-4	Rice Valley	188,100	1,200	0	0
7-42	Vidal Valley	137,700	10,000	100	0
7-3	Ward Valley	557,600	106,500	0	0

Groundwater basin areas were calculated using ArcGIS and the basin shapefile available from CDWR (http://www.water.ca.gov/groundwater/bulletin118/gwbasin_maps_descriptions.cfm). The calculated basin areas can be different than reported in the CDWR basin descriptions.

The basin area within each DRECP ecoregion subarea, herein referred to as the sub-basin, was determined by intersecting the CDWR groundwater basin shapefile with the DRECP ecoregion subarea boundary.
Reported acres of existing renewable energy projects having mapped locations within the sub-basin area. Note that the reported acres do not delineate between the renewable energy project footprint located within the CDWR basin boundary and portions of the footprint that might extend outside the basin boundary.
The following general rounding rules were applied to calculated values: values greater than 1,000 were rounded to the nearest 1,000; values less than 1,000 and greater than 100 were rounded to the nearest 100; values of 100 or less were rounded to the nearest 10, and therefore totals may not sum due to rounding. In cases where subtotals are provided, the subtotals and the totals are individually rounded. The totals are not a sum of the rounded subtotals; therefore the subtotals may not sum to the total within the table.

In the Piute Valley and Sacramento Mountains ecoregion subarea, less than 2% of the sub-basin area is disturbed; about 30% of the disturbed area is from agriculture. None of the basins receive imported water. The Needles Valley sub-basin is the most disturbed (10%), and 1% or less of the sub-basin areas in the Chemehuevi Valley, Piute Valley, and Vidal Valley is disturbed. There is no renewable energy development.

Within the Piute Valley and Sacramento Mountains ecoregion subarea, four of the seven basins partly or entirely overlie the Colorado River Aquifer, and one other basin is possibly tributary to the River Aquifer. Five basins within this ecoregion subarea are hydraulically connected (groundwater may flow between the connected basins), and none of the basins have a discharging playa.

The regional average annual precipitation recharge estimate in the Piute Valley and Sacramento Mountains ecoregion subarea is less than 4,000 acre-feet/year (Figure III 6-7). This number is the total for areas within the ecoregion subarea, including mountain blocks between basins. However, this estimate excludes rainfall in watershed areas located outside the DRECP area. The runoff from these outside watershed areas, if any, could contribute recharge as either percolating runoff or subsurface inflow. A discussion of the rainfall recharge estimates appears in Section III.6.3.3.2. Groundwater inflow or outflow with adjacent ecoregion subareas would affect the overall water budget of the Piute Valley and Sacramento Mountains ecoregion subarea.

The groundwater storage capacity of the Piute Valley and Sacramento Mountains ecoregion subarea is approximately 9 million acre-feet (16 AF/Ac), which was calculated by prorating Bulletin 118 basin storage capacities on a per-area basis. Reported well yields range from 65 to 980 gpm; one of the seven basins has no reported well-yield data. More than 250 wells with water-level data in the DWR Water Data Library are in this ecoregion subarea, and almost all of the wells are in the Needles Valley (70%) and Chemehuevi Valley (29%) basins.

Average TDS concentrations in the basins that comprise the Piute Valley and Sacramento Mountains ecoregion subarea range from 410 mg/L to almost 150,000 mg/L. Predominant ions in the groundwater include sodium, chloride, sulfate, and bicarbonate. There are also significant concentrations of fluoride and boron.

III.6.4.9 Providence and Bullion Mountains Ecoregion Subarea

The Providence and Bullion Mountains ecoregion subarea contains all or portions of 17 mapped DWR groundwater basins, of which 1,646,000 acres are in this ecoregion subarea. Table III.6-10 lists the basin names, total basin areas, and sub-basins. Additionally, Table III.6-10 shows the sub-basins that are disturbed by either agriculture or other developed land uses, and the footprint of existing renewable energy projects, in acres, where mapped locations fall within the sub-basins. (See Figure III.1-2[a] and Figure III.1-2[b] for a map of project locations and ecoregion subarea boundaries.)

Table III.6-10
California Department of Water Resources Basins in the Providence and Bullion Mountains Ecoregion Subarea of the DRECP

Basin Number	Groundwater Basin	Total Basin Area (acres)'	Portion of Basin (Sub-Basin) in Ecoregion Subarea'		
			Sub-Basin Area	*Disturbed Sub-Basin Area*	*Existing Renewable Energy Projects Located in Sub-Basin*
7-8	Bristol Valley	496,600	481,000	4,100	0
6-32	Broadwell Valley	91,800	91,800	200	0
7-7	Cadiz Valley	269,800	29,700	< 100	0
6-90	Cady Fault Area	7,900	7,400	0	0
6-38	Caves Canyon Valley	72,900	18,100	0	0
7-9	Dale Valley	212,400	89,500	400	0
7-13.01	Deadman Valley–Deadman Lake	89,000	1,200	0	0
7-2	Fenner Valley	452,400	452,400	200	0
6-30	Ivanpah Valley	197,900	2,200	0	0
6-31	Kelso Valley	254,600	10,300	< 100	0
7-1	Lanfair Valley	156,500	156,500	300	0
7-14	Lavic Valley	102,200	89,900	300	0
6-40	Lower Mojave River Valley	285,300	33,200	1,700	0
7-6	Pinto Valley	182,400	6,400	0	0
7-45	Piute Valley	175,100	64,400	0	0
6-33	Soda Lake Valley	379,800	13,700	0	0
7-3	Ward Valley	557,600	98,200	0	0

Groundwater basin areas were calculated using ArcGIS and the basin shapefile available from CDWR (http://www.water.ca.gov/groundwater/bulletin118/gwbasin_maps_descriptions.cfm). The calculated basin areas can be different than reported in the CDWR basin descriptions.

The basin area within each DRECP ecoregion subarea, herein referred to as the sub-basin, was determined by intersecting the CDWR groundwater basin shapefile with the DRECP ecoregion subarea boundary.
Reported acres of existing renewable energy projects having mapped locations within the sub-basin area. Note that the reported acres do not delineate between the renewable energy project footprint located within the CDWR basin boundary and portions of the footprint that might extend outside the basin boundary.
Groundwater storage capacity not reported for this basin in CDWR Bulletin 118.
The following general rounding rules were applied to calculated values: values greater than 1,000 were rounded to the nearest 1,000; values less than 1,000 and greater than 100 were rounded to the nearest 100; values of 100 or less were rounded to the nearest 10, and therefore totals may not sum due to rounding. In cases where subtotals are provided, the subtotals and the totals are individually rounded. The totals are not a sum of the rounded subtotals; therefore the subtotals may not sum to the total within the table.

Five of the 17 basins listed in Table III.6-10 are almost entirely within the Providence and Bullion Mountains ecoregion subarea (90% or more of their total basin area is located in the ecoregion subarea). These 5 sub-basins represent 45% of the Providence and Bullion Mountains ecoregion subarea. These are sub-basins of the Bristol Valley, Broadwell Valley, Cady Fault Area, Fenner Valley, and Lanfair Valley. Of the remaining 12 sub-basins, 5 represent less than 10% of their basins: Deadman Valley–Deadman Lake, Ivanpah Valley, Kelso Valley, Pinto Valley, and Soda Lake Valley basins. These 5 sub-basins together represent less than 2% of the ecoregion subarea.

In the Providence and Bullion Mountains ecoregion subarea, less than 0.5% of the sub-basin areas is disturbed, and only 21% of the disturbed area is from agriculture; only one of the sub-basins (Lower Mojave River Valley) receives imported water. The Lower Mojave River Valley sub-basin is the most disturbed (5%), and 1% or less of the other sub-basins is disturbed. There is no existing renewable energy development.

Eleven basins within the Providence and Bullion Mountains ecoregion subarea are hydraulically connected (groundwater may flow between the connected basins), and four basins have discharging playas: Bristol Valley, Cadiz Valley, Dale Valley, and Soda Lake Valley. The southern end of the Cadiz Valley basin overlies the Colorado River Aquifer, and the Pinto Valley basin is also tributary to the Colorado River Aquifer.

The regional average annual precipitation recharge estimate in the Providence and Bullion Mountains ecoregion subarea totals less than 11,000 acre-feet/year (Figure III 6-7). This number is the total for areas within the Providence and Bullion Mountains ecoregion subarea, including mountain blocks between basins. However, this estimated rainfall recharge excludes rainfall in watershed areas located outside the DRECP area. The runoff from these outside watershed areas, if any, could contribute recharge as either percolating runoff or subsurface inflow. A discussion of the rainfall recharge estimates appears in Section III.6.3.3.2. Groundwater inflow or outflow with adjacent ecoregion subareas would affect the overall water budget of the Cadiz Valley and Chocolate Mountains ecoregion subarea.

Groundwater storage capacity is reported for 16 of the 17 groundwater basins in the Providence and Bullion Mountains Subarea. The groundwater storage capacity of these 16 basins is approximately 24 million acre-feet (14 AF/Ac), which was calculated by prorating Bulletin 118 basin storage capacities on a per-area basis. Reported well yields range from 16 to 1,000 gpm; three of the 17 basins have no reported well-yield data. More than 100 wells with water-level data in the DWR Water Data Library are located in this ecoregion subarea. Most of these wells are found in Lower Mojave River Valley (48%), Fenner Valley (25%), and Lanfair Valley (16%).

Average TDS concentrations in the Providence and Bullion Mountains ecoregion subarea basins range from 350 mg/L to almost 150,000 mg/L. Predominant ions in the groundwater include sodium, bicarbonate, chloride, calcium, and sulfate. In areas near playas, the groundwater is typically high in sodium and chloride. There are also significant concentrations of fluoride and boron, and the Lower Mojave River Valley Basin contains nine LUST sites and one Superfund site contaminated with TCE, MTBE, BTEX, and other petroleum-based compounds. The groundwater in the Ivanpah Valley Basin contains radioactive constituents from naturally occurring rare earth ore bodies and their associated industrial processes related to active and historic mining of these ore bodies.

III.6.4.10 West Mojave and Eastern Slopes Ecoregion Subarea

The West Mojave and Eastern Slopes ecoregion subarea contains all or portions of 20 mapped DWR groundwater basins, of which 2,754,000 acres are in this ecoregion subarea. Table III.6-11 lists the basin names, total basin areas, and sub-basins. Additionally, Table III.6-11 shows the sub-basins that are disturbed by either agricultural or other developed land uses, and the footprint of existing renewable energy projects, in acres, where mapped locations fall within the sub-basins. (See Figure III.1-2[a] and Figure III.1-2[b] for a map of project locations and ecoregion subarea boundaries.)

Nine of the 20 basins listed in Table III.6-11 are almost entirely within the West Mojave and Eastern Slopes ecoregion subarea (90% or more of their total basin areas is located in the ecoregion subarea). These nine sub-basins represent 60% of the West Mojave and Eastern Slopes ecoregion subarea. These are sub-basins of the Antelope Valley, Coso Valley, El Mirage Valley, Fremont Valley, Harper Valley, Indian Wells, Kelso Lander Valley, Tehachapi Valley East, and Tehachapi Valley West basins. Of the remaining 11 sub-basins, five represent less than 10% of their basins: Cummings Valley, Kern River Valley, Rose Valley, Searles Valley, and Upper Santa Ana Valley–Cajon. These five sub-basins together represent less than 0.3% of the ecoregion subarea.

In the West Mojave and Eastern Slopes ecoregion subarea, almost 12% of the sub-basin areas are disturbed and only 18% of the disturbed area is from agriculture. Four of the basins receive imported water: Antelope Valley, Lower Mojave River Valley, Middle Mojave River Valley, and Upper Mojave River Valley. The Antelope Valley, Brite Valley, Lower Mojave River Valley, Tehachapi Valley East, Tehachapi Valley West, and Upper Mojave River Valley sub-basins are the most disturbed, with 17% to 76% of their areas disturbed. Almost 1% of this ecoregion subarea has renewable energy project development, with the greatest acreages in the Antelope Valley (15,000 acres), Fremont Valley (4,000 acres), and Harper Valley (2,000 acres).

Nine basins in the West Mojave and Eastern Slopes ecoregion subarea are hydraulically connected (groundwater may flow between the connected basins), and 2 basins (Fremont Valley and Searles Valley) have discharging playas.

Table III.6-11
California Department of Water Resources Basins in the West Mojave and Eastern Slopes Ecoregion Subarea of the DRECP

Basin Number	Groundwater Basin	Total Basin Area (acres)'	Portion of Basin (Sub-Basin) in Ecoregion Subarea'		
			Sub-Basin Area	*Disturbed Sub-Basin Area*	*Existing Renewable Energy Projects Located in Sub-Basin*
6-44	Antelope Valley	1,009,700	953,000	161,800	15,400
5-80	Brite Valley	3,200	2,000	900	0
6-55	Coso Valley	25,500	23,900	0	0
6-50	Cuddeback Valley	94,800	76,000	100	0
5-27	Cummings Valley	10,000	< 100	< 100	0
6-43	El Mirage Valley	75,800	73,100	5,700	< 100
6-46	Fremont Valley	335,000	317,200	16,400	4,000
6-47	Harper Valley	409,200	401,400	7,900	1,800
6-54	Indian Wells Valley	381,500	361,100	21,600	100
6-69	Kelso Lander Valley	11,200	11,200	< 100	0
5-25	Kern River Valley	79,400	3,900	100	0
6-40	Lower Mojave River Valley	285,300	36,700	11,200	0
6-41	Middle Mojave River Valley	211,200	153,900	5,800	0
6-56	Rose Valley	42,500	300	< 100	0
6-53	Salt Wells Valley	29,500	23,200	300	0
6-52	Searles Valley	196,900	3,200	0	0
6-45	Tehachapi Valley East	24,000	24,000	5,200	0

Table III.6-11
California Department of Water Resources Basins in the West Mojave and Eastern Slopes Ecoregion Subarea of the DRECP

Basin Number	Groundwater Basin	Total Basin Area (acres)′	Portion of Basin (Sub-Basin) in Ecoregion Subarea′		
			Sub-Basin Area	*Disturbed Sub-Basin Area*	*Existing Renewable Energy Projects Located in Sub-Basin*
5-28	Tehachapi Valley West	14,800	14,800	11,200	0
6-42	Upper Mojave River Valley	412,500	274,600	77,400	< 100
8-2.05	Upper Santa Ana Valley–Cajon	23,200	200	< 100	0

Groundwater basin areas were calculated using ArcGIS and the basin shapefile available from CDWR (http://www.water.ca.gov/groundwater/bulletin118/gwbasin_maps_descriptions.cfm). The calculated basin areas can be different than reported in the CDWR basin descriptions.
The basin area within each DRECP ecoregion subarea, herein referred to as the sub-basin, was determined by intersecting the CDWR groundwater basin shapefile with the DRECP ecoregion subarea boundary.
Reported acres of existing renewable energy projects having mapped locations within the sub-basin area. Note that the reported acres do not delineate between the renewable energy project footprint located within the CDWR basin boundary and portions of the footprint that might extend outside the basin boundary.
Groundwater storage capacity not reported for these basins in CDWR Bulletin 118.
The following general rounding rules were applied to calculated values: values greater than 1,000 were rounded to the nearest 1,000; values less than 1,000 and greater than 100 were rounded to the nearest 100; values of 100 or less were rounded to the nearest 10, and therefore totals may not sum due to rounding. In cases where subtotals are provided, the subtotals and the totals are individually rounded. The totals are not a sum of the rounded subtotals; therefore the subtotals may not sum to the total within the table.

The regional average annual precipitation recharge estimate for the West Mojave and Eastern Slopes ecoregion subarea totals about 52,000 to 58,000 acre-feet/year (Figure III 6-7). This number is the total for areas that fall within the ecoregion subarea, including mountain blocks between basins, and includes parts of the adjacent San Bernardino–San Gorgonio Mountains. Annual precipitation exceeds 20 inches per year near these mountain summits, and other basin and ecoregion subarea areas within the DRECP area might not include similar recharge generating mountain areas. Therefore, recharge in basin areas adjacent to these mountains might be substantially greater than for the sub-basin areas within the ecoregion subarea boundaries. For example, a comprehensive study of groundwater conditions in the Mojave River basin estimated average annual total recharge during 1931–1990 to equal 150,300 AF/year, of which two-thirds derived from mountain front recharge and runoff originating in upper watershed areas (Stamos et al. 2001). A discussion of the rainfall recharge estimates appears in Section III.6.3.3.2. Groundwater inflow or outflow with adjacent ecoregion subareas would affect the overall water budget of the West Mojave and Eastern Slopes ecoregion subarea.

Groundwater storage capacity is reported for 16 of the 20 groundwater basins in the West Mojave and Eastern Slopes ecoregion subarea. The groundwater storage capacity of these 16 basins is approximately 100 million acre-feet (36 AF/Ac), which was calculated by prorating Bulletin 118 basin storage capacities on a per-area basis. Reported well yields range from 60 to 3,650 gpm; three of the 19 basins have no reported well-yield data. More than 5,500 wells with water-level data in CDWR Water Data Library are in this ecoregion subarea. Most are located in Antelope Valley (41%), Upper Mojave River Valley (17%), Indian Wells Valley (10%), and Lower Mojave River Valley (10%) basins. Significant subsidence has been measured in areas near Lancaster and Edwards Air Force Base, where by 1992 almost 190,000 acres had subsided more than 1 foot.

Average TDS concentrations in the West Mojave and Eastern Slopes ecoregion subarea basins range from 130 to 21,500 mg/L. Predominant ions in the groundwater include sodium, calcium, bicarbonate, chloride, and sulfate. There are also significant concentrations of boron, fluoride, nitrate, arsenic, iron, and magnesium. Middle Mojave River Valley Basin groundwater can contain high concentrations of volatile organic compounds and salts due to irrigation with effluent and leaching from a landfill. The Lower Mojave River Valley and Upper Mojave River Valley basins contain 10 LUST sites and two Superfund sites contaminated with TCE, MTBE, BTEX, and other petroleum-based compounds. In the Indian Wells Valley, groundwater pumping has caused relatively poor quality shallow groundwater to leak down and negatively impact water quality in the deeper aquifer. The Middle Mojave River Valley Basin groundwater also contains chromium, both naturally occurring and associated with industrial processes.

III.6.4.11 BLM LUPA Decision Area Outside of DRECP Area

The BLM LUPA Affected Environment for groundwater resources includes almost 1.08 million acres of BLM-administered lands that are under the BLM CDCA Plan but outside the DRECP area. About 33% of these lands (355,000 acres) overlays 35 CDWR groundwater basins, and the remaining area is not associated with any groundwater basin identified by DWR. Of the 35 affected groundwater basins, 18 are partially located in the DRECP area, while the remaining 17 basins are entirely outside the DRECP area. The 18 basins in the DRECP area with acreages within the BLM LUPA Decision Area but outside the DRECP area are summarized in Table III.6-12. Most of the outside acreages are small, and only 4 of the 18 basins have more than 5% of their total acreage on BLM CDCA lands outside the DRECP area.

Table III.6-12
Department of Water Resources Basins in BLM LUPA Affected Environment but Outside the DRECP Area

Basin Name	Total Basin Area (acres)	Basin Area within the CDCA Lands outside the DRECP Area (acres)	Percent of Basin within the CDCA Lands outside the DRECP Area
Antelope Valley	1,009,700	< 50	< 1%
Borrego Valley	152,500	3,200	2%
Butte Valley	8,800	< 50	< 1%
Chocolate Valley	129,100	30,600	24%
Coachella Valley–Indio	297,000	26,500	9%
Coachella Valley–Mission Creek	48,500	11,200	23%
Coyote Wells Valley	145,600	7,500	5%
Death Valley	919,800	300	< 1%
East Salton Sea	194,800	1,500	< 1%
Imperial Valley	957,600	< 50	< 1%
Indian Wells Valley	381,500	500	< 1%
Kern River Valley	79,400	100	< 1%
Orocopia Valley	96,200	37,300	39%
Owens Valley	660,700	13,800	2%
Panamint Valley	259,100	4,700	2%
Rose Valley	42,500	1,900	< 1%
Searles Valley	196,900	300	< 1%
Vallecito-Carrizo Valley	121,700	2,200	< 1%

Note: The following general rounding rules were applied to calculated values: values greater than 1,000 were rounded to the nearest 1,000; values less than 1,000 and greater than 100 were rounded to the nearest 100; values of 100 or less were rounded to the nearest 10, and therefore totals may not sum due to rounding. In cases where subtotals are provided, the subtotals and the totals are individually rounded. The totals are not a sum of the rounded subtotals; therefore the subtotals may not sum to the total within the table.

III.6.5 Groundwater Resources for BLM-Managed Lands

The LUPA Decision Area overlaps parts of 91 DWR-delineated groundwater basins representing more than 6.7 million acres, which is 43% of the total area of groundwater basins in the DRECP area. The basin acreages within DRECP part of the LUPA Decision Area are summarized in Table III.6-13.

Table III.6-13
California Department of Water Resources Basins within BLM LUPA Decision Area

Basin Name	Total Basin Area (acres)	Area in BLM LUPA Decision Area (acres)	Percent of Basin Acreage Affected
Ames Valley	108,400	28,300	26%
Amos Valley	129,900	82,400	63%
Antelope Valley	1,009,700	11,300	1%
Arroyo Seco Valley	256,500	106,500	42%
Bessemer Valley	39,000	28,100	72%
Borrego Valley	152,500	34,300	22%
Bristol Valley	496,600	317,900	64%
Broadwell Valley	91,800	85,500	93%
Cadiz Valley	269,800	233,300	86%
Cady Fault Area	7,900	5,600	71%
California Valley	58,100	55,500	96%
Calzona Valley	80,600	43,100	53%
Caves Canyon Valley	72,900	43,000	59%
Chemehuevi Valley	272,100	228,400	84%
Chocolate Valley	129,100	28,900	22%
Chuckwalla Valley	601,500	488,800	81%
Coachella Valley–Mission Creek	48,500	200	<1%
Copper Mountain Valley	30,300	1,900	6%
Coyote Lake Valley	88,000	45,300	51%
Coyote Wells Valley	145,600	97,500	67%
Cronise Valley	126,200	46,700	37%
Cuddeback Valley	94,800	65,800	69%
Dale Valley	212,400	132,500	62%
Deadman Valley–Surprise Spring	29,200	600	2%
Death Valley	919,800	46,400	5%
Denning Spring Valley	7,200	2,800	39%
East Salton Sea	194,800	30,700	16%
El Mirage Valley	75,800	5,000	7%
Fenner Valley	452,400	194,600	43%
Fremont Valley	335,000	93,200	28%
Grass Valley	10,000	6,700	67%
Greenwater Valley	59,800	100	<1%
Harper Valley	409,200	199,300	49%
Imperial Valley	957,600	319,800	33%

Table III.6-13
California Department of Water Resources Basins within BLM LUPA Decision Area

Basin Name	Total Basin Area (acres)	Area in BLM LUPA Decision Area (acres)	Percent of Basin Acreage Affected
Indian Wells Valley	381,500	150,700	40%
Iron Ridge Area	5,200	5,000	96%
Ivanpah Valley	197,900	74,000	37%
Johnson Valley–Soggy Lake	77,200	47,800	62%
Johnson Valley–Upper Johnson Valley	34,800	32,500	93%
Joshua Tree	27,200	700	3%
Kane Wash Area	5,900	4,000	68%
Kelso Lander Valley	11,200	2,600	23%
Kelso Valley	254,600	38,800	15%
Kern River Valley	79,400	2,400	3%
Lanfair Valley	156,500	13,300	8%
Langford Valley–Langford Well Lake	19,300	1,300	7%
Lavic Valley	102,200	36,600	36%
Leach Valley	60,900	8,500	14%
Lower Kingston Valley	239,600	228,000	95%
Lower Mojave River Valley	285,300	118,900	42%
Lucerne Valley	147,300	68,500	47%
Means Valley	14,900	13,800	93%
Mesquite Valley	88,100	72,200	82%
Middle Amargosa Valley	389,500	285,000	73%
Middle Mojave River Valley	211,200	91,900	44%
Morongo Valley	7,200	600	8%
Needles Valley	87,900	45,000	51%
Ocotillo–Clark Valley	222,100	69,500	31%
Ogilby Valley	133,200	119,200	89%
Orocopia Valley	96,200	9,000	9%
Owens Valley	660,700	133,200	20%
Owl Lake Valley	22,200	200	<1%
Pahrump Valley	92,800	73,800	80%
Palo Verde Mesa	225,000	136,400	61%
Palo Verde Valley	73,000	500	<1%
Panamint Valley	259,100	143,400	55%
Pilot Knob Valley	138,500	1,000	<1%
Pinto Valley	182,400	3,800	2%

Table III.6-13
California Department of Water Resources Basins within BLM LUPA Decision Area

Basin Name	Total Basin Area (acres)	Area in BLM LUPA Decision Area (acres)	Percent of Basin Acreage Affected
Pipes Canyon Fault Valley	3,400	1,900	56%
Piute Valley	175,100	109,800	63%
Quien Sabe Point Valley	25,100	12,900	51%
Red Pass Valley	96,200	6,100	6%
Rice Valley	188,100	164,200	87%
Riggs Valley	87,500	59,600	68%
Rose Valley	42,500	26,800	63%
Salt Wells Valley	29,500	11,000	37%
Searles Valley	196,900	147,400	75%
Silver Lake Valley	35,200	32,600	93%
Soda Lake Valley	379,800	136,400	36%
Superior Valley	120,200	23,500	20%
Tehachapi Valley East	24,000	4,100	17%
Twentynine Palms Valley	62,200	8,800	14%
Upper Kingston Valley	176,700	87,700	50%
Upper Mojave River Valley	412,500	37,700	9%
Upper Santa Ana Valley–Cajon	23,200	100	<1%
Vallecito-Carrizo Valley	121,700	4,800	4%
Vidal Valley	137,700	123,600	90%
Ward Valley	557,600	523,100	94%
Warren Valley	23,700	200	<1%
West Salton Sea	105,300	13,100	12%
Yuma Valley	124,000	57,500	46%

Note: The following general rounding rules were applied to calculated values: values greater than 1,000 were rounded to the nearest 1,000; values less than 1,000 and greater than 100 were rounded to the nearest 100; values of 100 or less were rounded to the nearest 10, and therefore totals may not sum due to rounding. In cases where subtotals are provided, the subtotals and the totals are individually rounded. The totals are not a sum of the rounded subtotals; therefore the subtotals may not sum to the total within the table.

III.6.6 Affected Environment Outside the DRECP Area

The transmission required outside the DRECP area would generally fall into four geographic areas: San Diego, Los Angeles, Central Valley, and the Rialto/Moreno Valley/Devers areas. An overview of the existing groundwater, water supply, and water quality in the basins underlying transmission corridors in each of these areas follows; information is generally summarized from DWR Bulletin 118 (DWR 2003). The regulatory setting related to groundwater, water supply, and water quality outside the DRECP area includes the laws, ordinances, and regulations described in Section III.6.1, Regulatory Setting.

III.6.6.1 San Diego Area

The transmission corridor in the San Diego Area would traverse seven groundwater basins: Coyote Wells Valley, Campo Valley, Cottonwood Valley, Jacumba Valley, Poway Valley, Potrero Valley, and San Diego River Valley. Of these, Coyote Wells Valley Basin extends into the DRECP area and is described in Section III.6.4.2, Groundwater Resources within the DRECP area.

These groundwater basins are small, ranging from 3.2 to 15.4 square miles. They are typically bounded by the impermeable crystalline rocks of the Peninsular Ranges. The primary water-bearing deposits of these basins are Quaternary alluvium and residuum.

Storage capacity is unknown for most of the basins in the San Diego area; however, the estimated capacity for the San Diego River Valley Basin is 97,000 acre-feet and 63,450 acre-feet for the Campo Valley Basin. Recharge is from direct precipitation. Septic tank effluent and irrigation waters also provide some recharge.

The alluvium typical of most basins in the San Diego Area contains water of calcium bicarbonate character trending toward sodium chloride in the westernmost basin (Poway Valley). Impairment is unknown for several basins. High chloride and high TDS levels make water from some wells in the Poway Basin inferior for agricultural or domestic use. Similarly, the northern portions of the Jacumba Valley Basin are characterized by high TDS.

III.6.6.1.1 Alternatives

The affected environment for the alternatives in the San Diego Area is the same as in the Preferred Alternative.

III.6.6.2 Los Angeles Area

The transmission corridor in the Los Angeles Area would traverse six groundwater basins: Coastal Plain of Los Angeles, San Gabriel Valley, Upper Santa Ana Valley, Raymond, Upper Mojave River Valley, Antelope Valley. Of these, Upper Mojave River Valley and Antelope Valley extend into the DRECP area and are described in Section III.6.4.10, West Mojave and Eastern Slopes Ecoregion Subarea.

The affected groundwater basins in the Los Angeles Area underlie portions of the San Gabriel Valley as well as the upper Santa Ana River Watershed in San Bernardino County and portions of western Riverside and Los Angeles counties. The water-bearing materials of the groundwater basins in the Los Angeles area are dominated by unconsolidated to semi-consolidated alluvium deposited by streams flowing out of neighboring mountains. These deposits include Pleistocene and Holocene alluvium and the lower Pleistocene San Pedro Formation. Upper Pleistocene alluvium deposits form most of the productive water-bearing deposits in these basins. Several faults, including the Raymond Fault, Rialto-Colton Fault, Chino Fault, San Jose Fault, and Cucamonga Fault, as well as impermeable and consolidated rocks, act as barriers to groundwater movement in portions of the groundwater basins in the Los Angeles area.

Total storage capacity of the groundwater basins in the Los Angeles Area ranges from 18,300,000 acre-feet in the Chino Sub-Basin of the Coastal Plain of Los Angeles Groundwater Basin to approximately 1,450,000 acre-feet in the of Raymond Groundwater Basin. Natural recharge is primarily from direct percolation of precipitation and percolation of ephemeral stream flow from neighboring mountains and applied water in spreading grounds.

Maximum contaminant levels (MCLs) are exceeded in several public supply wells for various contaminants, including TDS, nitrate, volatile organic compounds (VOCs), perchlorate, N-nitrosodimethylamine (NDMA), inorganics, radiology, semi-VOCs, pesticides, and perchlorate (DWR 2006).

III.6.6.2.1 Alternatives 1, 3, and 4

Alternatives 1, 3, and 4 are the same as the Preferred Alternative in the Los Angeles area, with an additional new 500 kV transmission line corridor from the Vincent Substation to Los Angeles Department of Water and Power's (LADWP) upgraded Station E Substation. The affected environment for these alternatives is the same as for the Preferred Alternative, with the addition of the San Fernando Valley Groundwater Basin.

The San Fernando Valley Groundwater Basin is bordered on the north and northwest by the Santa Susana Mountains, on the north and northeast by the San Gabriel Mountains, on the east by the San Rafael Hills, on the south by the Santa Monica Mountains and Chalk Hills, and on the west by the Simi Hills. It is drained by the Los Angeles River and its tributaries. Water-bearing sediments consist of the lower Pleistocene Saugus Formation, and Pleistocene and Holocene alluvium. Several faults, rock types, and subsurface dams create complete or partial barriers to groundwater movement within the basin.

The total storage capacity of the San Fernando Valley Groundwater Basin is approximately 3,670,000 acre-feet. Recharge of the basin is from a variety of sources including spreading imported water and infiltration from natural streamflow from the surrounding mountains and precipitation.

Water is predominately of calcium sulfate-bicarbonate or calcium bicarbonate character. Primary contaminants include VOCs and elevated sulfate concentrations.

III.6.6.2.2 Alternative 2

In the Los Angeles area, Alternative 2 is the same as for the Preferred Alternative, with an additional new 500 kV transmission line corridor from the Vincent Substation to the Moorpark Substation. The affected environment for these alternatives is the same as for the Preferred Alternative, with the addition of the Las Posas Valley and Acton Valley groundwater basins.

The Acton Valley Groundwater Basin is bounded by the Sierra Pelona Mountains on the north and the San Gabriel Mountains on the south, east, and west; this basin is drained by the Santa Clara River. The Las Posas Groundwater Basin underlies the Las Posas Valley in southern Ventura County. In this basin, Arroyo Las Posas drains surface waters westward to the Pacific Ocean.

Alluvium is the primary water-bearing material in both basins. Additional water-bearing materials in the Las Posas Basin include the San Pedro Formation and the Santa Barbara Formation. Faults are not barriers to groundwater movement in the Action Basin. Movement of groundwater in the Las Posas Basin is restricted by various folds, synclines, and faults.

The total storage capacity is estimated at 40,000 acre-feet in the Acton Valley Basin and 345,000 acre-feet in the Las Posas Basin. The basins are primarily recharged from percolation of precipitation on the valley floors. The Acton Basin is also recharged by subsurface inflow.

Groundwater in the basins is primarily calcium bicarbonate in character. Impairments include high concentrations of TDS, sulfate, and chloride.

III.6.6.3 Central Valley

The transmission corridor outside the DRECP area in the Central Valley is primarily within the San Joaquin Valley Groundwater Basin, which includes numerous sub-basins and is bordered on the west by the Coast Ranges, on the south by the San Emigdio and Tehachapi mountains, on the east by the Sierra Nevada and on the north by the Sacramento–San Joaquin Delta and Sacramento Valley. On the east side of the Tehachapi Mountains, the corridor is within the Antelope Valley Groundwater Basin, which extends into the DRECP area and is further described in Section III.6.4.10, West Mojave and Eastern Slopes Ecoregion Subarea.

The southern portion of the San Joaquin Valley is internally drained by the Kings, Kaweah, Tule, and Kern Rivers that flow into the Tulare drainage basin, including the beds of the former Tulare, Buena Vista, and Kern lakes. The northern portion of the valley drains toward the Sacramento-San Joaquin Delta by the San Joaquin River and its tributaries: the Fresno, Merced, Tuolumne, and Stanislaus rivers.

Most basin aquifers in the Central Valley are composed of unconsolidated Quaternary alluvial deposits underlain by older unconsolidated to semi-consolidated Quaternary to Tertiary alluvial deposits.

Barriers to groundwater movement include various faults such as the Edison, Pond-Poso, and White Wolf faults, as well as folds such as the Elk Hills and Buena Vista Hills. Corcoran Clay restricts vertical movement of groundwater in some areas.

Storage capacity reported in DWR Bulletin 118 varies widely in the basin, up to more than 80,000,000 acre-feet in its northern parts. The majority of outflows are agricultural extraction. Other extraction sources include urban use, oil-industry-related use, and minimal subsurface outflow. Recharge is primarily from stream recharge and from deep percolation of applied irrigation water. Groundwater extraction and deep compaction of fine-grained units has caused subsidence within the basin.

Water types vary across the basin, from calcium bicarbonate in the shallow zones where sodium generally increases with depth. Bicarbonate is replaced by sulfate and reduced in chloride from east to west across the basin. Shallow groundwater presents problems for agriculture in the basin, including high TDS, sodium chloride, sulfate, arsenic in localized areas, nitrate, dibromochloropropane (DBCP), and ethylene dibromide (EDB). Groundwater at certain locations contains selenium and boron that may affect usability.

III.6.6.3.1 Alternatives

The affected environment for the alternatives in the Central Valley is the same as the Preferred Alternative.

III.6.6.4 Rialto/Moreno Valley/Devers Area

The transmission corridor in the Rialto/Moreno Valley/Devers Area would traverse seven groundwater basins: East Salton Sea, Chocolate Valley, Orocopia Valley, Coachella Valley, San Jacinto, Upper Santa Ana Valley, and Upper Mojave River Valley. Of these, East Salton Sea, Chocolate Valley, Orocopia Valley and Upper Mojave River Valley extend into the

DRECP area and are described in Section III.6.4.1, Cadiz Valley and Chocolate Mountains Ecoregion Subarea, and Section III.6.4.2, Imperial Borrego Valley Ecoregion Subarea. The Upper Santa Ana Valley Groundwater Basin extends into the Los Angeles Area and is described in Section III.6.9.1.2, Los Angeles Area.

A portion of the transmission corridor is within the Desert Hot Springs Sub-Basin of the Coachella Valley Groundwater Basin. This sub-basin underlies the northeastern portion of the Coachella Valley. The San Jacinto Groundwater Basin underlies the San Jacinto, Perris, Moreno, and Menifee valleys, which are drained by the San Jacinto River and its tributaries. The primary water-bearing materials in these basins are relatively undisturbed alluvial fan deposits of the late Pleistocene and Holocene eras. Several faults create barriers to groundwater movement including the Mission Creek, Banning, Indio Hills, San Jacinto, Claremont, Hot Springs, Park Hill, and Casa Loma faults as well as smaller, related faults that parallel these larger faults.

The estimated groundwater storage capacity of the San Jacinto Basin and Desert Hot Springs is 3,070,000 and 4,100,000 acre-feet, respectively. Natural recharge to these basins is primarily from percolation of flow in the water courses and infiltration. In the San Jacinto Basin, natural recharge is augmented by spreading of State Water Project and reclaimed water through infiltration ponds throughout the valley. In years with low precipitation, artificial recharge can exceed natural recharge.

In the San Jacinto Groundwater Basin, typical groundwater character is sodium chloride, sodium-calcium chloride, calcium-sodium chloride, or calcium-sodium chloride-bicarbonate. The Desert Hot Springs Sub-Basin is characterized by sodium sulfate type groundwater with high temperatures in some areas. In both basins, TDS is an environmental concern.

III.6.6.4.1 Alternatives 1 and 3

The affected environment for alternatives 1 and 3 is the same as for the Preferred Alternative.

III.6.6.4.2 Alternatives 2 and 4

Alternatives 2 and 4 would include the same lines in the Rialto/Moreno Valley/Devers Area as the Preferred Alternative. Additionally, Alternatives 2 and 4 would require a new 500 kV line from the Lugo Substation to the Serrano Substation. The affected environment for these alternatives is the same as for the Preferred Alternative, with the addition of the Coastal Plain of Orange County Groundwater Basin.

The Orange County Basin underlies the lower Santa Ana River watershed. An upper, middle, and lower aquifer system exists in this basin. The water-bearing formations within these aquifers include Holocene alluvium, older alluvium, stream terraces, and upper Pleistocene deposits (upper); lower Pleistocene Coyote Hills and San Pedro Formations (middle); and Upper Fernando Group of upper Pliocene Age (lower). There are three fault zones within this basin that restrict groundwater flow: Newport-Inglewood, Whittier, and Norwalk.

The total capacity of the Orange County Basin is 38,000,000 acre-feet. Recharge to the basin is primarily from percolation of Santa Ana River flow, infiltration of precipitation, and recharge injection wells.

Water within the basin is primarily sodium-calcium bicarbonate. Impairments of concern include increasing salinity, high nitrates and methyl tertiary butyl ether (MTBE).